in New Zealand universities: an environmental scan

Report to CONZUL, 12 August 2019

Open Access in New Zealand universities: an environmental scan[1]

A project within the Council of New Zealand University Librarians Open Access programme.

The CONZUL Open Access project team is pleased to submit the infographic *"NZ Open Access: what do we know?"* and the report of the Environmental Scan we undertook of the current state of Open Access publishing in New Zealand universities. The report also covers global developments relevant to New Zealand's situation. The Open Access Project team had representatives from 7 universities including:

Emma Richardson	University of Auckland	Team Leader, Research Services
Luqman Hayes	Auckland University of Technology	Team Leader, Scholarly Communications
Jessica Howie	Waikato University	Researcher Support Librarian
Bruce White	Massey University	Copyright and Open Access Advisor
Anton Angelo	University of Canterbury	Research Data Co-ordinator
Stuart Broughton	University of Canterbury	Manager, Research Services
Moira Fraser (Project Lead)	University of Canterbury	Library Project Lead
Deborah Fitchett	Lincoln University	Head of Department: Digital Services
Richard White	University of Otago	Manager Copyright & Open Access

The CONZUL Open Access Governance Group provided invaluable guidance and advice to the project team throughout the 4 months we have been working on this report.

Kim Tairi	Auckland University of Technology	University Librarian
Annette Beattie	Universities New Zealand	Portfolio Manager - Cross-sector Projects
Anne Scott (CONZUL lead for Open Access)	University of Canterbury	University Librarian

The work of the project benefited greatly from two experts who worked with the project team at our June workshop and subsequently.

Professor Virginia Barbour	Queensland University of Technology	Executive Director, Australasian Open Access Strategy Group
Mandy Henk	Tohatoha	Chief Executive

This version of the Infographic of the current state of Open Access in New Zealand universities and accompanying Environmental Scan report are approved by CONZUL for general release.

[1] Open Access image from https://commons.wikimedia.org/wiki/File:Open_Access_logo_PLoS_white.svg modified by Creative Commons New Zealand (now Tohatoha) in 2013.

Contents

Executive Summary

The impact of NZ universities' research can be increased by a co-ordinated approach to Open Access (OA) publishing. Elsewhere in the world, particularly in Europe and the US, research funders, governments and universities have coordinated efforts to ensure research is widely available and re-usable, at no charge to read. New Zealand is disadvantaged compared to other countries that have adopted a defined and co-ordinated strategy for Open Access and the gap is widening. We can improve the visibility and impact of our research and close that gap by implementing an appropriate action plan, modelled upon the overseas practices most relevant to New Zealand.

Our analysis of the **current state of Open Access in NZ**, which includes a detailed analysis of research journal articles published by NZ universities in 2017, had these key findings.

Access to research

- Research articles in open repositories which can be accessed by everyone, are cited 66% more than articles behind paywalls, accessible only to researchers whose institutions pay subscriptions to the journals.
- Slightly over half (51%) of university research which is publicly funded by our biggest research funders (HRC, Marsden and others) is behind a paywall - inaccessible to government agencies and to the New Zealand public.
- 41% of research articles are openly accessible where any of the authors are from a NZ university. This number falls to 34% where the NZ researcher is the lead author.
- Only half (22%) of our open research articles were accessible to everyone immediately and with re-use licenses. The remaining half which are openly accessible, either have a status which may change over time, were embargoed for a period and/or lacked a re-use license.
- Open articles were referenced in the media 3.5 times more than closed ones and mentioned in policy documents twice as often.

Open infrastructure

- Our universities and researchers are missing out on an opportunity to improve their research impact through Open Access. 3090 articles published in 2017 which are behind paywalls, could now be deposited in open repositories within the terms of the publishing agreements.
- Only five of the eight universities have OA policies or guidelines. Aligning our OA policies and guidelines would support stronger transformative agreements with publishers.
- All 8 universities have open repositories which is a significant factor in achieving citation advantage for NZ university research

Article Processing charges/publishing fees

- Paying an Article Processing Charge (APCs) for journal articles in paywalled journals (Hybrid OA) achieves a slightly higher citation rate than publishing in an open repository but at a significantly higher cost.
- 60% of the APC expenditure is with 4 key academic library suppliers. Most NZ university spending on APCs is currently ad hoc and difficult to identify.

Global developments

Our analysis of the global developments in Open Access, revealed different approaches that can serve as models to enable Aotearoa to make faster progress towards Open Access. These include:

- Australian universities, like NZ, provide Access through the provision of institutional repositories. F.A.I.R. initiatives provide highly relevant models we can draw from. CONZUL already has a robust partnership with CAUL.
- CONZUL continues to work closely with CAUL as subscriptions move to transformational "read and publish" deals. CONZUL will need to work closely with CAUL to manage APCs, particularly with the big 4 vendors.
- The University of California approach to Open Access strategy, where their libraries have taken the leadership role, provides an exemplar for building support across the university. Their governance is similar to CONZUL.
- In many north European countries, universities are collaborating with the wider research community, particularly research funders to create national strategies to negotiate with publishers. These initiatives provide useful foundations to develop a national strategy for Open Scholarship.

Actions

CONZUL has agreed to work together on progressing Open Access in 4 areas:

- Advocacy within NZ universities
- Alignment with Australia – partnerships with CAUL and AOASG
- Collaborative work on a small number of projects across all universities
- Co-operation and knowledge sharing

"*Equal access to science is not only a social and ethical requirement for human development, but also essential for realizing the full potential of scientific communities worldwide and for orienting scientific progress towards meeting the needs of humankind".*

The World Conference on Science, 1999, held under the auspices of UNESCO and ICSU

Context for this report

This report from the CONZUL Open Access project group describes the current state of open access (OA) in New Zealand universities. A major part of the group's work was a detailed analysis of data from university research outputs in 2017, details of which are included throughout. Further information about the overall findings and the methodology for this work are reported in the appendices.

As noted by CONZUL in its own definition of *open scholarship*, there are many definitions of open access, open science, open scholarship, open teaching practices, etc. which may encompass many elements of scholarly endeavour from research ethics, through research data management, to publishing and archiving practices, and in some definitions, teaching practices and educational resources. These elements are broad ranging and in a state of flux: the focus of this paper is on **access to research publications** so the terms open access or OA are used throughout with this sense. Open scholarship, more broadly, is outside of the scope of this project.

Increasingly, libraries are under pressure to meet inflationary prices of 'Big Deal' subscription packages. CONZUL's figure for subscriptions to electronic resources in 2017 was NZ$65m.[2] One strategy for containing the inflationary pressures was to work closely with our Australian counterparts in order to increase our negotiating power for consortia deals for subscriptions which reduced both negotiation and purchase costs. Despite this, the largest academic publishers make huge profits. "Elsevier, Sage, and Taylor & Francis (major for-profit publishers) … are making 40 percent profits … in 2017, Elsevier reported a $1.2 billion profit."[3] The same publishers that are our largest suppliers of subscriptions to journals are the publishers we pay the most for APCs.[4]

The diagram below from the University of California illustrates how publishers are double dipping.[5]

[2] Figure provided by CONZUL during the submission process for the Copyright Act review.
[3] https://news.lib.berkeley.edu/crusade-open-access-and-what-library-doing-help-explained
[4] Refer to the table on p.26 of the top 10 publishers showing a detailed breakdown of which publishing suppliers NZ university researcher's use.
[5] https://osc.universityofcalifornia.edu/wp-content/uploads/2019/07/UpdateOnOpenAccessAndAcademicJournalContracts_UCBoardOfRegentsAcademicAndStudentAffairsCommittee_17July2019.pdf

The University of California is paying publishers with the left and the right hand

The University of California provides a useful model for its work with the academic community to build a university wide mandate for its OA strategy. Their system is comparable to CONZUL:

- in scale - 10 campus libraries independently led
- In budget for electronic subscriptions - US$40m/NZ$59.4m compared to our NZ$65m
- In payments for OA publishing - US$10m/NZ$14.9m compared to our $2.1m estimated cost of APCs
- 250,000 students compared to NZ's 172,000

University of California adopted an OA policy in 2013 and negotiated for all 10 campuses to sign Open Access 2020; the international statement expressing intent to shift paywall funding towards paying for open access. With high level support, the University of California cancelled its agreement with Elsevier in February 2019. They will return to the negotiating table with Elsevier, only if Elsevier is willing to address their public mission principles: full open access for UC authors, and cost containment to properly steward public funds. [6]

In the past year other major research institutions across Europe are cancelling their big deals[7] -- and the subscription costs that go with them -- at the cost of access to research. Alongside these developments, several large national library consortia have moved to – or are in the process of negotiating – 'publish and read' deals with major publishers, which typically incorporate inflation and 3% annual increases. Under such arrangements, libraries continue to pay subscription fees but in return research published by those institutions with those publishers is OA without APCs. Such deals, of course, continue to divide the research ecosystem in that this only benefits institutions who can make such deals.

Another approach that provides a useful model for understanding the value of a strategic national approach is the work with research funders, predominantly in Europe. This approach, given impetus by OA2020 and Plan S. aims for fundamental change to the scholarly ecosystem to enable full access to all research outputs. Plan S, a coalition of around 20 major funding organisations, including Wellcome and the Gates Foundation, has a bold goal of fast transformation:

[6] https://osc.universityofcalifornia.edu/wp-content/uploads/2019/07/UpdateOnOpenAccessAndAcademicJournalContracts_UCBoardOfRegentsAcademicAndStudentAffairsCommittee_17July2019.pdf
[7] sparcopen.org/our-work/big-deal-cancellation-tracking/

> With effect from 2021, all scholarly publications on the results from research funded by public or private grants provided by national, regional and international research councils and funding bodies, must be published in Open Access Journals, on Open Access Platforms, or made immediately available through Open Access Repositories without embargo.[8]

To advance this ambitious goal, Plan S has called for APCs to be commensurate with the services provided, for alignment of policy and practice by all stakeholders and, essentially, for an end to Hybrid models of publication. A second iteration of the Plan, responding to extensive stakeholder feedback, has incorporated Green OA as a path to open access, which makes it more relevant to the NZ environment.

In some cases, researchers took control (or regained it) of the publication process. This is evidenced by:

- the number of preprint servers[9],
- cases like the well-documented resignation of an entire linguistics journal board to set up their own OA journal[10]
- universities hosting journals (as with AUT's Tuwhera platform and other repository-based journals, as discussed further below).

University libraries can't subscribe to everything our researchers want to read or provide to their students. In 2017, in NZ our libraries accessed 32,465 items through the interlibrary loan system.[11] There is also strong demand for university research outputs which are behind paywalls in the wider community. The Open Access Button, a website that helps people ask researchers for copies of their articles, has logged over 260,000 cases where people have explained why they need these articles which they have no access to.[12] The open citation advantage described in this report also suggests that content available openly is in demand.

Publishers have marketed Hybrid journals effectively as their preferred route towards OA. Researchers pay to have their work made openly accessible: our data suggests an average Hybrid APC cost of NZ$3,800. Researchers also pay APCs for Gold OA (i.e. where all articles in a publication are immediately OA and there is no subscription fee), with the average cost here being NZ$2,500. More detail on these costs is covered in the section below on Gold / Hybrid OA - APCs.

---

[8] Coaltion S (2019). 'Part I: The Plan S principles' from Plan S website. www.coalition-s.org/principles-and-implementation/ Accessed 3 July 2019.

[9] The Open Science Framework is "a free and open source project management tool that supports researchers throughout their entire project lifecycle." (See more: cos.io/our-products/osf/). It provides the framework for over 30 preprint servers across 10 broad subject areas, hosting over 2.3 million preprints as of July 2019 (as quoted on osf.io/preprints/, accessed 19 July 2019).

[10] Milmo, Cahal. (5 Nov 2015). 'Lingua: Entire editorial team of respected linguistics journal resign en mass in turf war over publishing,' The Independent. Accessed 19 July 2019. www.independent.co.uk/news/world/europe/lingua-entire-editorial-team-of-respected-linguistics-journal-resign-en-mass-in-turf-war-over-a6723036.html

[11] Council of Australian University Librarians (2017). *Summary Statistics.* Data retrieved from statistics.caul.edu.au/pre2018/inst_data.php

[12] 269696 requests for access recorded at openaccessbutton.org/request. Accessed 2 July 2019.

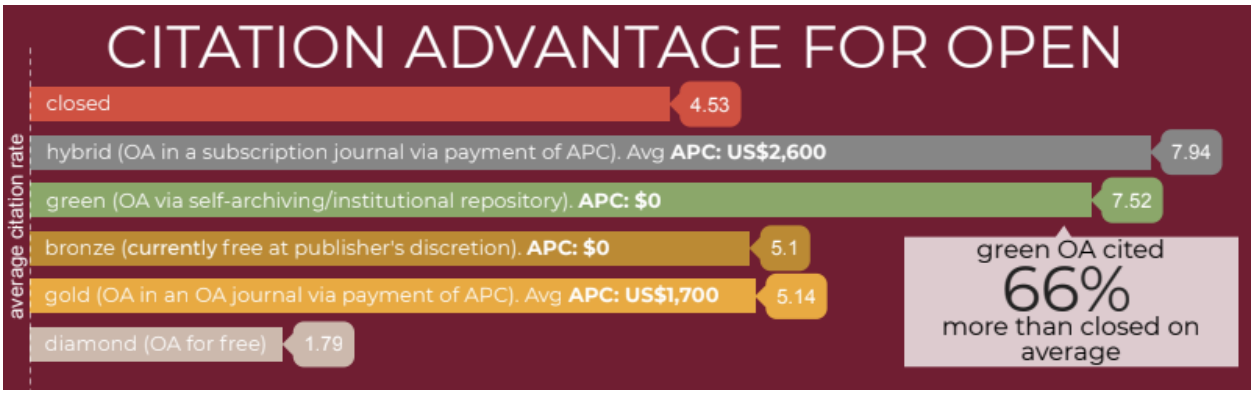
Calculating from these figures, it would have cost at least NZ$11 million if we had to pay APCs to convert the closed research outputs into open access.

By contrast, according to publishers' policies, most of this same research could be made open via Green OA. Scaling up the use of Green OA would entail additional staffing and infrastructure costs but less than scaling up Gold or Hybrid OA publishing. A 2015 study found that the processing cost of depositing an article in an institutional repository, including the time of the author, was £33[13] (or about NZ$62 as of July 2019). Using this figure the 3,090 articles that are closed but could be open would cost $191,580 to deposit.

The value of OA Publishing to New Zealand

Citation advantage

OA carries a citation advantage by increasing the reach of research, when compared to research that is only available via a subscription. A large-scale global study in 2018 estimated an 18% citation advantage according to recent global research[14] but our own research indicates this is much higher for New Zealand research outputs.



Here Green OA achieves the second-highest average citation rate, approaching twice the average citation rate of closed research. These figures equate to:

- an overall 44% citation advantage for open access NZ articles compared to closed access;
- a 66% citation advantage for articles available through Green OA (e.g. in institutional repositories) compared to closed; and
- a significant advantage for Green OA compared to other forms of OA, with the exception of Hybrid.

[13] Johnson, R., Pinfield, S., & Fosci, M. (2016). Business process costs of implementing "gold" and "green" open access in institutional and national contexts. *Journal of the Association for Information Science and Technology, 67*(9), 2283-2295. doi.org/10.1002/asi.23545

[14] Piwowar H, Priem J, Larivière V, Alperin JP, Matthias L, Norlander B, Farley A, West J, Haustein S. 2018. The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ* 6:e4375 doi.org/10.7717/peerj.4375

Citation rates are important for PBRF and for university rankings: QS World Rankings puts a 20% rating on 'citations per faculty member'; the THES ranking has a 30% weighting; and the ARWU 'Shanghai' ranking 20%.[15]

Further analysis of the journals behind these figures, and researchers' reasons for their choice of publication venue, would be required to provide more insight into the nature of the citation advantage. Is there a difference in size or marketing of Hybrid journals compared to Gold journals that affects the number of citations? Do other factors, such as discipline, have an effect on the citation advantage?

Wider impact: access for those without subscriptions

Open availability of original peer-reviewed research gives the academic community a direct and unfiltered voice in political, social and cultural discourse, ensuring that the public has access to research, particularly research that is publicly-funded.

- OA enables impact by opening up access and thereby helping research to inform:
    - policy (in support of strategic objectives of the government, such as wicked research problems)
    - professional practice
    - business practice/innovation/entrepreneurship
    - news/media
    - education (at all levels);
- OA facilitates equitable access to knowledge, whether for the public or for students and researchers at institutions without subscription access to relevant research;
- OA facilitates collaboration through greater visibility
    - between disciplines
    - between sectors (e.g. academia and industry)
    - between institutions.

Improved citation rates are one measure of impact, and we have detailed above the open citation advantage but citations mostly measure impact upon other academic researchers. Globally there is an emerging trend to measure non-academic impact in research evaluation exercises including RE and ERA overseas, and PBRF in New Zealand. Altmetrics.org uses DOIs to determine the frequency with which articles are referenced in tweets, Facebook posts, Wikipedia articles, mainstream news media stories, and official policy documents.

In our sample it was found that open articles were cited in the media 3.5 times more than closed ones and mentioned in policy documents twice as often. This advantage increased slightly for articles primarily available through repositories which were 3.7 times more likely to be cited in the media and 2.5 times more likely to be mentioned in policy documents. While the absolute numbers of policy

[15] QS methodology www.topuniversities.com/qs-world-university-rankings/methodology; THES www.timeshighereducation.com/world-university-rankings/methodology-world-university-rankings-2018; ARWU www.shanghairanking.com/ARWU-Methodology-2018.html.

documents mentioning the research in our sample were small, and we have reservations about the overall effectiveness of Altmetric's methodology in this area, the difference between the two sample sets is striking enough to suggest that this is genuine evidence of the greater reach and impact of openly available research. Research that is referenced by policymakers and the media is more likely to have real-world outcomes than research that is cited only by the academic community.

Local projects have demonstrated that depositing research outputs in an institutional repository substantially increased the visibility of our work. In 2014 a University of Otago research centre adopted a policy to deposit its previous five years' research outputs that were not available openly and to continue this as a standard practice from that time. As a result, downloads of their work have increased nearly fivefold.[16]

Overall, however, if New Zealand universities were to receive a report card on our efforts to make our work accessible the outcome would be: must do better.

The data analysis we undertook on 2017 research outputs found 41% of our research is openly accessible in some format, where the paper in question had at least one author affiliated with a NZ university. This figure decreases to 34% when the corresponding author was a NZ university researcher. It should be noted, however, that these overall figures include any type of openly accessible material in either the published form or in a reputable repository (academic networking sites like ResearchGate are not included). Of all the articles in our sample, three-quarters of the open articles had been made available on the publisher's site, meaning only one quarter was in a repository of some sort, which would include our own repositories but also PubMed and other similar sites. This quarter of open work represents 10% of all the articles including closed ones.

Beyond whether articles were open or closed, we were also able to analyse the type of access for the articles in our set. Here we have used the colour coding system (see Appendix 5) often applied to open access materials. This analysis shows that for all articles **only 22% was available openly in its published form immediately on publication** (Gold+Hybrid+Diamond OA); 10% was available Green OA and therefore its availability may have been delayed due to publisher embargoes. A further 9% was Bronze OA, this category being where an open version of the work can be located but its status is uncertain (such as when publishers make material available without charge for a certain period). As such including this 9% in our overall figure represents a reasonable proportion (i.e. around a quarter of all our open articles) where that status is not certain and may not be permanent.

When we look at the same figures but focusing on New Zealand corresponding authors, the immediate-OA figure reduces further to 18% (Gold+Hybrid+Diamond) with 8% more available via Green OA. Here Bronze is also 8%. As detailed below in the section on mandates, our proportion of Green OA is much less than other countries. Looking at this New Zealand author subset, we can see that we have paid for immediate OA for 16% of all our articles (i.e. Gold+Hybrid, Diamond being free to readers) with an estimated cost of US$1.45m/NZ$2.16. More detail on the cost of paid OA is provided in the section on APC payments.

[16] See detailed data in Appendix 4: CSAFE deposit policy effect on access to work.

A detailed breakdown for each university in the appendices of articles by type of access along with citation rate averages for each type. To pick out a few highlights from these details:

- Overall, the results are broadly similar across the universities: for all articles the open proportion ranges from 45% (Lincoln) to 38% (Massey); for articles where one of our researchers was the corresponding author the range is 38% (Otago) to 27% (Massey).
- In terms of raw volume, the University of Auckland alone has 1752 closed articles.
- For Green OA (all authors) the range is 8% of all articles (Otago) to 13% (a figure shared by Waikato, VUW, and Canterbury); for the New Zealand-author subset the range is more spread, from 4% (Massey) to 15% (AUT, Waikato).
- For paid OA (Gold+Hybrid, NZ author set only), again a spread is evident. Auckland has the highest number of articles (265), with Otago very close to that figure on 258. These two, in terms of volume, are clearly paying for more OA, with Massey a distant third on 96. Examining the proportion of paid OA in relation to total output, we see that the highest is 20% (Otago) and the lowest 9% (VUW). The average proportion of paid OA is 15%.

We have also estimated that even for research funded by our major funding agencies only 49% was available openly.

Open scholarship is better scholarship

Open access:

- brings greater transparency to the research process, minimising duplication and double-funding;
- is underpinned by and supports:
    - Sustainable Development Goal G 16.10 (**Ensure public access to information** and protect fundamental freedoms, in accordance with national legislation and international agreements). Contributions to the SDGs are an indicator in the Times Higher Education Impact Rankings[17]
    - Article 27 of UN Declaration of Human Rights (Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and **to share in scientific advancement and its benefits**)
    - ensures the full breadth of resources are available to those working to achieve the SDGs and other UN initiatives.

[17] Mamtora, Jayshree and Pandey, Prashant (2018) *Identifying the role of open access information in attaining the UN Sustainable Development Goals*. Paper presented at: Societies in Session 205 - Asia and Oceania. library.ifla.org/2110/1/205-mamtora-en.pdf

Mandates: New Zealand universities & global trends

University of Auckland	Open Access Guidelines
Auckland University of Technology	
University of Waikato	Open Access Mandate Guidelines
Massey University	
Victoria University Wellington	(in development)
University of Canterbury	Mandatory deposit in the institutional research repository
Lincoln University	Open Access Policy Research Output Mandate (under review)
University of Otago	Open Access Policy and Open Access Guidelines

Five of the eight universities currently carry OA mandates, policies or guidelines. They vary greatly in terms of the strength of their wording and their effectiveness, since most leave it to the discretion of researchers as to where to publish. What each does have in common is that Green OA is the recommended path for researchers to make their work openly accessible. Recent research indicates only a small correlation between strength of wording and compliance.[18] Mandates by funders tend to be more powerful in terms of compliance because they can hold back payments in response to non-compliance. The UK's Wellcome Trust and the US National Institute of Health have a compliance rate of around 90%.[19] Meaningful mandates by institutions are a key enabler for Green OA and government-led initiatives are also known to increase OA, as are policies tied to research evaluation exercises, for example, the REF2021 Open Access Policy in the UK. The UK far outstrips other nations in the proportion of its research outputs that are openly accessible according to the Leiden ranking.

As indicated above, the proportion of OA for NZ corresponding authors is less than for all papers: 34% of articles are open where the corresponding author is affiliated with a NZ universities; 41% of all articles are open irrespective of the affiliation of the corresponding author. In other words overseas research is more likely to be openly accessible than ours.

[18] Vincent- Lamarre, P. , Boivin, J. , Gargouri, Y. , Larivière, V. and Harnad, S. (2016), Estimating open access mandate effectiveness: The MELIBEA score. J Assn Inf Sci Tec, 67: 2815-2828. doi:10.1002/asi.23601
[19] www.nature.com/articles/d41586-018-07101-w

The Leiden Ranking tool[20] uses a different method to that employed by our group, including using data from 2014-17, but is a useful tool to evaluate global trends and compare its results to our own. Leiden's figure for the proportion of NZ research that is openly available in some form is 38.4%. This compares to Canada 42%, Australia 42%, Germany 48%, Ireland 49%, Norway 54%, United States 54%, and United Kingdom 71%. 34 of the top 50 universities for proportion of OA research are from the UK; New Zealand's top-ranked university is the University of Canterbury at number 416 in the list.

Attitudes of university staff to OA

There is a strong attitudinal support for OA amongst New Zealand academics as evidenced by the results from recent surveys, along with reports from project team members and developments within a number of universities.

The 2018 Ithaka S+R survey[21] explored the attitudes and behaviours of research and teaching staff in six of New Zealand's eight universities towards open access and found positive attitudes and support for OA as well as a high level of participation in existing OA publishing.

Green OA

- 76% of respondents have peer-reviewed journal articles or conference proceedings openly accessible (e.g. in an open repository).
- 48% have pre-prints of peer-reviewed journal articles in an open access repository (or similar).

Benefit to the public and practitioners

- 46% rated it very important that their research reaches the general public while 68% believed it extremely important that professionals outside academia have access to their research.
- 68% agree that enabling the broadest possible readership of their research is important for maximising the impact of their findings.

Open publishing models

- 60% of respondents would be very happy to see "the traditional subscription-based publication model replaced entirely by an open access publication system in which all scholarly research outputs would be freely available to the public (though recognising that there will still be costs for publishing)".

Open access policies

- 87% of respondents would support (and 72% highly support) a policy at their institution that publicly funded scholarly research be made available online at no charge to readers (such as in an institutional repository).

[20] More detail about the Leiden Ranking is included in Appendix 3: Leiden Ranking data.
[21] Blankstein, M., & Wolff-Eisenberg, C. (2019, April 12). Ithaka S+R US Faculty Survey 2018. doi.org/10.18665/sr.311199

AUT's Tuwhera open journal hosting is one example of the way in which academics and institutional divisions are increasingly materially supporting OA. Tuwhera launched in 2016, hosting two peer reviewed journals. It has grown exponentially and now supports nine peer reviewed titles, one open research summary publication, a monograph series and conference proceedings. Interest in the service has spread throughout NZ's universities and has given AUT a platform with which to network with open access strategists across the Pacific region. Within AUT itself the profile of Tuwhera has enabled discussion of the benefits of open access to be raised at strategic level with a view to drafting policy.

Despite the above – and perhaps due to the effect of PBRF evaluation criteria and traditional 'publish or perish' attitudes affecting career progression – nervousness, misunderstanding and misinformation surrounds Green OA and the process and possibilities created by self-archiving via AUT's institutional repository.

Otago's open access publishing survey (2017)[22] indicated similar attitudes, specifically that, while OA is strongly supported in principle, "behaviours are driven by the practicalities of cost and publication venue." The report states, more explicitly:

- Otago researchers believe that research articles should be freely available to all, in one of the clearest results in the survey, with 86% agreeing or strongly agreeing with this statement.
- Equally clearly, there was strong agreement that obtaining funding to publish OA is a barrier that prevents adoption, with 84% agreeing/strongly agreeing.

This same survey found that a 59% of researchers did not know there was an institutional repository; a further 29% said they were aware of it but had not used it, with most of those saying they didn't know how to use it or simply saw no need.

Other reasons that our researchers do not deposit their work include that:

- they may be concerned the deposit will breach the copyright agreement that they signed with their publisher;
- They may feel pressure to maximise impact, as measured for PBRF and QS Rankings, and feel concern about the time it takes after start-up, for open access journals to be ranked by Scopus
- they may regard the submitted or accepted manuscript as a secondary or inferior product that will diminish the prestige of their published work;
- they may consider sharing their work through academic networking sites like ResearchGate or Academia.edu an easier or better way of making it open access;
- they may regard the academic community as being their important audience and not be aware of benefits of moving beyond that enclosed community;
- they may equate electronic publication with open access and be simply unaware that their work is inaccessible to a majority of people; or

[22] White, R., & Remy, M. (2017). University of Otago Open Access Publishing Survey Results (including Maori ethnicity results) (Project Report). Retrieved from hdl.handle.net/10523/7333

- they may feel the process of locating and depositing an accepted manuscript is simply too difficult, especially in comparison with the ease of uploading to ResearchGate.

The alacrity with which ResearchGate was adopted by researchers[23] suggests that they see a benefit in wider accessibility to their works. The ease of uploading articles, viral marketing tactics, and the appearance of "legitimacy" were attractive features that led to a rapid spread in use of this and similar academic networking sites. However, universities should be wary of such services: these are commercial operations, not research repositories, and their long-term future is uncertain. The Social Sciences Research Network was purchased by Elsevier, while ResearchGate and Academia have faced opposition from publishers and had to remove infringing documents.

All universities have noted increasing numbers of enquiries from new researchers from overseas institutions asking whether the Library supports APCs for the Open Access journal they are publishing in. These researchers are often surprised to find no financial support from universities or funders for OA publishing. As noted elsewhere in this document, most New Zealand universities have no such centralised fund and no major funder has an OA policy or directly supports APC fees.

The figures from the Ithaka S+R and Otago surveys suggest researcher support for OA is much higher than the number of people who publish or deposit their work openly. In the Ithaka survey 87% support OA as a principle and 68% indicated it was important for professionals to access their work but only 48% said that they make pre-publication versions available in some form and the project's own research indicates that less than that is open overall. In the University of Otago survey 81% of respondents (n=395) had not deposited work in the institutional repository. Thus the barriers – of cost, where APCs are required, of a lack of consistency in terms of policies and mandates, of a lack of understanding about OA, especially the possibilities of Green OA, and of usability – are real and appear to be significantly impacting the openness of our research and the advantages this confers.

How much do universities invest in open access?

Green OA - Institutional repositories

Under the Green OA route, the published version of an article is closed access AND an open access copy is uploaded to a discipline repository or an institutional repository. Every university in New Zealand has an institutional repository maintained by its library. Most universities use the same software, and all share expertise and best practices.

- University of Auckland – ResearchSpace
- AUT – Tuwhera Open Repository
- University of Waikato – Research Commons
- Massey University – Massey Research Online
- Victoria University of Wellington - ResearchArchive

[23] 64% of respondents in the Otago survey indicated sharing their work on an academic networking site. This contrasts with only 11% of the same sample set reporting having deposited work in the institutional repository.

- University of Canterbury – UC Research Repository
- Lincoln University – Research@Lincoln
- University of Otago – OUR Archive

While all eight institutional repositories have a general goal of making the university's research openly accessible, the focus varies. Some collect the full range of scholarly outputs from their staff and student researchers, including journal articles, conference contributions, reports, student theses and more. Some, like Otago's and Massey's repositories, are primarily targeted at supporting student theses and dissertations and have relatively less open access content from academic staff. The University of Canterbury's repository includes its own journals and conferences, which other institutions manage through separate systems.

In addition to the variation in scholarly output types, different repositories include different mixes of:

- fully open access content;
- content restricted to staff/student access for copyright reasons; and
- content held for admin-only access, for purposes of PBRF verification and auditing.

University investment in repositories

The costs of running a repository may include:

- Hosting and server licence costs
- Hosting technical support
- Software purchase or licensing
- Software development – upgrades and new features
- Software technical support – configuration, user interface customisation, troubleshooting
- Open access admin – processing submissions, checking permissions

The estimated annual costs are about $100,000 for each New Zealand university, with a range from $18,000 to $180,000 per annum. In all cases, staffing costs of open access administration are the most significant component. These staff help researchers to identify which version of their article can legitimately be deposited, undertake search-engine optimisation, check metadata for accuracy and provide software support.

It is difficult to determine which repository costs are dedicated to making content open. As described in the previous section, repositories host other scholarly output types and some host significant quantities of closed content. Moreover, in some universities, like Lincoln, repository staff work closely with the research office and much of their work may overlap with functions supporting PBRF administration as well as open access support. Software supporting PBRF also benefits from integrations with repository software.

The repository may benefit from integration with PBRF processes and research management software that makes it easier for researchers to submit content. Some universities like Auckland also

use an Open Access Monitor module embedded in this software to encourage deposits. Costs of running this software have not been included in the estimate above.

The future of repositories

University libraries could undertake work to make significantly more content openly accessible and re-usable - content where the author currently has the right to deposit in a repository, but has not done so. Administrative work is needed to confirm permissions, liaise with researchers to locate the correct version for upload, and add bibliographic data to ensure discoverability of the content.

As noted above, staffing is the greatest cost of running a repository and to date libraries have not resourced repositories at a staffing level needed to keep up with current deposits, let alone undertake follow-up of research articles which are now out of embargo.

Libraries are well positioned to support Green OA and open up access to more of our researchers' content. This will, however, require some more investment in repository staffing.

Gold / Hybrid OA - APCs

It has proven very difficult to establish how much universities spend on APCs to publish work openly. Only Lincoln University, University of Canterbury, and the University of Otago's Wellington school have a centralised APC fund, and even in these cases the fund only supports a portion of APCs paid by researchers. Remaining APCs may be paid out of research grants or other miscellaneous budgets, with each faculty or department having its own practices.

One method to estimate a total spend is to use the large data analysed as part of this project -- that is, calculating the costs of known APCs for all research outputs in a particular timeframe that were published in a medium that would have required the payment of an APC. This is a largely theoretical figure because:

- fees are often waived,[24]
- not all fee information is available in the data sources we are using
- it is impossible to know for certain which of the authors in a cross-institution collaboration paid the fee.

In our data analysis the estimated figure is US$1.45m/NZ$2.16, with a larger proportion of this being spent on OA-only journals that charge an APC (US$1.17m/NZ$1.75m) than Hybrid journals.

As a more accurate means of measuring actual expenditure on APCs one university has analysed its financial records. When the University of Otago introduced its open access policy in 2016, a new category was introduced in the finance system to track APC payments. To aid this, information has

[24] 36% of researchers in Otago's survey who had published OA reported said a journal had waived the fee. Reasons provided included being invited to write as an expert on a particular topic and as recompense for providing peer review or editorial services.

been disseminated to those staff entering financial records in the system so that the right details are recorded to analyse the data. 2018 data were analysed to calculate the amount spent of APC payments at the University of Otago, with the following results.

- NZ$411,000 spent in total on Article Processing Charges on 178 publications in 2018, an average of NZ$2,308 per publication.
- Most commonly Otago is spending on journals that are open access-only (NZ$243,000), with a relatively small amount spent on APCs in Hybrid journals (NZ$29,000). For the remainder (NZ$139,000) it was impossible to tell from the information in the finance system which type of publication it was. It is useful to track payments in Hybrid journals because (a) we are likely also paying subscription fees to access that journal and (b) as we have seen similar or better citation rates can be achieved through Green OA, which is free apart from staff time to deposit publications in repositories.
- Three-quarters of spending was in the Health Sciences Division. This is expected in the context of Otago and in that these disciplines generally have more mandates from funders and from publishers themselves to publish research openly. However, this may also reflect a lack of funding available in other areas to pay for APCs, this having been highlighted in Otago's 2016 survey of OA publishing practices by staff, where some staff were unable to publish in their preferred journal because there was no funding to support this.

Note: these figures should be considered to be minimum amounts because (a) in some cases the notes made in the finance system as to the nature of the transaction do not make it clear exactly what the money was spent on (e.g. page charges or other editorial/publishing services sometimes incur charges even for closed publications) and (b) there might be other payments categorised differently and therefore not captured in the data harvested from the finance system. A similar attempt was made at an Australian university to determine actual payments on APCs using the supplier codes associated with publishers. CAUL has a current project focused on APC costs.[25]

Diamond OA - University-hosted open access journals

In addition to hosting Green open access articles in repositories, many university libraries maintain systems to host open access journals managed by their own researchers. Most of these journals are both free to read and free to publish in (sometimes called 'diamond' open access). Most libraries are hosting from 2 - 12 journals.

- AUT - tuwhera.aut.ac.nz/open-peer-reviewed-journals
- Victoria University of Wellington - ojs.victoria.ac.nz/
- University of Canterbury - ir.canterbury.ac.nz/handle/10092/11178
- Lincoln University - journals.lincoln.ac.nz/
- University of Otago - www.otago.ac.nz/library/for/staff/ourjournals.html#journals

[25] www.caul.edu.au/programs-projects/fair-affordable-open-access-knowledge/collection-reporting-apcs

‘Publish anywhere, deposit here’

University researchers are overwhelmingly in favour of open access to their published research but have proven reluctant to place accepted manuscripts in green repositories. We have discussed the barriers that prevent researchers depositing work that is otherwise closed, including the fact that most will not understand the extent of publisher allowances. The four major publishers, who account for around 59% of the articles in our sample,[26] all allow deposit of a Green OA version of their articles, usually after an embargo period. In fact we have been able to determine the allowances for deposit of an accepted manuscript down to the level of the policy of each individual journal, finding that:

- authors published in 5,248 unique journals, 4,562 (87%) of which were not open;
- of these closed journals 18% allow immediate deposit of accepted manuscripts and a further 57% allow it after 12 months;
- in total, 84% of titles allow archiving of accepted manuscripts within 18 months or less.

Yet there are over 3000 articles in our sample set not available openly that could be; Green OA only accounts for only a quarter of our open research and 10% of all our research. Therefore it is clear that deposit of an accepted manuscript has not become standard practice, meaning that we are not maximising the impact of our research, especially compared to other countries. We could substantially increase the national quantum of openly accessible research by taking advantage of the publishers’ Green allowances and normalising the ethic of “Publish anywhere, deposit in an open-access repository.” Hypothetically, if we deposited the 3090 closed articles with a New Zealand corresponding author this would flip the numbers: only 8% of this work from 2017 would be closed, 92% open, and 66% would be available via Green OA. A more strategic approach could be devised, for example focusing efforts on certain disciplines, articles that have already been well cited or that will impact PBRF or university rankings.

Sidebar: Beyond journal articles

While the scope of this report focuses on journal articles, the broader open access movement is progressing on multiple fronts. New Zealand university libraries are keeping pace with these as resourcing permits. Many areas will become of increasing importance in the future, and require increased funding to support.

- **Open research data** - journals increasingly require datasets underpinning results to be published openly. Some universities are investigating or implementing open data repositories to support this.
- **Open protocols / open code** - similar movements call for publication of the methods used to gather data, and the algorithms used to analyse it, to ensure reproducibility.
- **Open educational resources** (OER) - sharing teaching materials lets lecturers avoid reinventing the wheel; and gives a preview of courses to potential students.
- **Open textbooks** - textbook costs are a major barrier for many students. Universities can support the development (either for a single course or collaboratively across multiple institutions) of open textbooks that students can use for free.
- **Open conference proceedings** - conference websites tend to be ephemeral. Some universities are beginning to support archiving proceedings as they do journals.
- **Open heritage** - universities have important art, museum, and archival collections and other taonga. Sharing these digitally increases interest in them and the university and facilitates research by removing access barriers for researchers.

Arguments for Green depositing of accepted manuscripts

- It is cost-effective: an average APC is around US$1,800 per article,[27] while Green deposit requires no APC and the overall business cost is much less per article (NZ$62). Repository infrastructure already exists at each university. Therefore staff support and standard processes would be all that was required – work should be undertaken to establish possible models to achieve this at scale.
- The depositing of accepted manuscripts in institutional repositories is allowed after embargo by all the major publishers; in fact, they also allow immediate deposit of the submitted manuscript.
- Institutional repositories are a better and more secure long-term prospects for the preservation and accessibility of work than sites like ResearchGate and academia.edu which lack both a guaranteed financial model and legal clarity, and are not harvested in open access tools such as Unpaywall.
- The citation advantage of open access is similar for accepted manuscripts on a Green repository compared to publishers' versions in Hybrid OA journals, and better than for publishers' version in Gold OA journals.

Conclusion

Many of the trends identified in this report are similar to findings in other countries. However, we can see the gap in quantity and quality of open access research articles that exists between New Zealand and countries or regions with co-ordinated strategies and initiatives. We have identified and recommended a range of collaborative and co-ordinated activities that would enable us to close this gap.

[26] See the top 10 publishers in our sample in Appendix 2: summary of findings from data analysis.

[27] US$1800 is about NZ$2700. We note that the calculations done by the University of Otago on actual spend in 2018 put the average lower at NZ$2000 per APC.

Appendices

Appendix 1: Data analysis methodology and Data Extraction

Summary of Data Sources

DOIs for 2017 publications were extracted from Elements repositories of seven out of the eight New Zealand universities. Use of the Elements repositories meant that the sample was not restricted to those items indexed by Web of Science and Scopus. The exception was University of Otago which does not use Elements – in this case DOIs were sourced from Scopus.

Information on corresponding (reprint) authors and funders was captured by searching for the DOIs in Web of Science and Scopus. This information is not available from other sources which means that although the total figures relate to all DOIs from the universities, those relating to “local” reprint authors are restricted in this way. For each university a determination was made on the total number of local authors and whether the reprint author was local.

The following information was gathered by submitting the DOIs to the unpaywall API –

- The overall Open (“is_oa”) status of the document – TRUE or FALSE
- The specific status of the “best version” of the document ("oa_status") - closed, gold, hybrid, bronze, green
- Top level URLs of each repository in which it was found. These were available even when the primary status was not green, for example when copies of gold papers were also held in repositories
- The “genre” of each document – journal article, book chapter etc. The actual analysis was restricted to journal articles
- The version-type of the best version – published version, submitted version (preprint) or accepted version (accepted manuscript)
- The ISSN for each journal

Unpaywall is the most comprehensive source of information on the Access status of journal articles as it includes information from most (but not all) digital repositories.

Full data from the Directory of Open Access Journals was downloaded from https://doaj.org/csv. This included price and currency data for APCs and a clear statement if an APC was not charged. The presence of a journal in DOAJ could be used to verify gold status (unpaywall invariably got this right) and where no APC was charged the gold status obtained from unpaywall was changed to diamond.

Data on Sherpa/Romeo allowances was captured through the use of their API. (This proved to be more accurate in describing embargo periods than downloading CSV files from their website.) The following data was obtained for each ISSN on archival rights for Author accepted manuscripts and published versions.

Data on numbers of citations and on numbers of authors was obtained by submitting the DOI to the Crossref API.

Data on APCs was obtained from the GitHub site of Lisa Matthias (Freie Universität Berlin) – these are collected from publishers' websites.[28]

Analysis

Data were gathered from each university individually and was then amalgamated into a single file of more than 12,600 journal articles. If there was a local reprint author at any university for a given paper then it was designated as having a New Zealand reprint author. During the course of the project it was found that a small percentage of articles with large numbers of authors and large numbers of citations tend to skew the data so articles with more than 20 authors were excluded on the grounds that they had a tenuous connection to the New Zealand University that had submitted DOI. This reduced the sample size to 12,016.

The following information was extracted:

- Total percentage of open and closed papers in the sample
- Total percentage of papers in each of the access categories - closed, gold, hybrid, bronze, green. This related to the "best version" so there was no overlap between categories
- Total percentage of papers available through repositories. This related to all versions so there was overlap with the other categories
- The total cost for gold and hybrid papers if all APCs had been charged as advertised
- The total cost of APCs as advertised if they had been paid on papers available in repositories
- The total number of closed papers that could be made open as Author accepted manuscripts through Sherpa/Romeo allowances
- The total cost of APCs as advertised if these papers were made open in hybrid mode

[28] github.com/lmatthia/publisher-oa-portfolios

Appendix 2: summary of findings from data analysis

Overall results for closed v open

Articles with at least one author affiliated with a NZ university (all articles in sample):

Availability of article	Count	%	Avg of Crossref citations
Closed	7056	59%	4.53
Open	4960	41%	5.91
Total	**12016**	**100%**	**5.10**

Articles with NZ university researcher as corresponding author:

Availability of article	Count	%	Avg of Crossref citations
Closed	3502	66%	3.69
Open	1799	34%	4.88
Total	**5301**	**100%**	**4.09**

- 12016 articles in total; 5301 of those have a NZ author as the corresponding author.
- The proportion of OA for NZ corresponding authors is less than for all papers (34% v 41%), suggesting overseas authors are more likely to utilise Green OA than we are. This result is supported by the external tool Leiden Ranking, where NZ universities' proportion of OA is less than Australia, the US and the UK.[29]

OA articles by type of access

Articles with at least one author affiliated with a NZ university (all articles in sample):

Type of access	Count	%	Avg of Crossref citations
Bronze	1101	9%	5.11
Closed	7056	59%	4.53
Diamond	265	2%	1.79
Gold	1706	14%	5.14
Green	1259	10%	7.52
Hybrid	629	5%	7.94
Total	12016	100%	5.10

[29] See Appendix 3 for data from the Leiden Ranking.

Articles with NZ university researcher as corresponding author:

Type of access	Count	%	Avg of Crossref citations
Bronze	423	8%	4.93
Closed	3502	66%	3.69
Diamond	95	2%	1.45
Gold	697	13%	4.74
Green	432	8%	**5.13**
Hybrid	152	3%	**6.84**
Total	**5301**	**100%**	**4.09**

OA articles by type of access: breakdown by university

The following tables show the open status for each university, i.e. a breakdown of the overall tables immediately above by institution.

Articles with at least one author affiliated with a NZ university (all articles in sample):

	Auckland			AUT			Waikato			Massey		
Type of access	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*
Bronze	303	10%	6.01	237	9%	6.11	55	9%	3.27	88	7%	3.09
Closed	1752	58%	5.58	1568	58%	4.89	369	61%	4.07	777	62%	3.74
Diamond	50	2%	1.38	68	3%	1.93	19	3%	1	28	2%	2.86
Gold	462	15%	6.21	396	15%	4.68	56	9%	3.77	196	16%	4.08
Green	316	10%	8.14	274	10%	9.03	77	13%	5.47	117	9%	6.43
Hybrid	163	5%	8.31	159	6%	7.4	25	4%	9.68	57	5%	7.25
Total	**3046**	**100%**	**6.06**	**2702**	**100%**	**5.46**	**601**	**100%**	**4.29**	**1263**	**100%**	**4.14**

VUW			Canterbury			Lincoln			Otago			
Total	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	***Type of access***
155	10%	2.84	66	8%	4.2	46	8%	5.02	244	11%	5.66	**Bronze**
959	60%	3.5	447	57%	3.52	336	55%	4.6	1354	58%	4.11	**Closed**
41	3%	1.88	16	2%	2.19	14	2%	1.79	40	2%	2.1	**Diamond**
168	10%	5.8	98	13%	3.99	100	16%	5.66	398	17%	5.24	**Gold**
203	13%	5.43	105	13%	5.63	70	11%	8.01	193	8%	8.1	**Green**
85	5%	11.89	49	6%	10.78	44	7%	9.5	88	4%	8.63	**Hybrid**
1611	**100%**	**4.32**	**781**	**100%**	**4.35**	**610**	**100%**	**5.49**	**2317**	**100%**	**4.94**	**Total**

Articles with NZ university researcher as corresponding author:

	Auckland			AUT			Waikato			Massey		
Type of access	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*
Bronze	135	9%	4.88	17	5%	22.29	16	6%	3.44	29	5%	2.45
Closed	977	65%	4.65	255	68%	3.51	165	65%	3.36	425	73%	3.03
Diamond	27	2%	1.04	1	0%	1	6	2%	1.33	8	1%	1.63
Gold	209	14%	6.07	42	11%	4.86	23	9%	2.52	83	14%	3.92
Green	101	7%	7.09	55	15%	3.65	39	15%	4.33	26	4%	2.92
Hybrid	56	4%	7.05	7	2%	2.86	6	2%	1.83	13	2%	5.31
Total	**1505**	**100%**	**5.06**	**377**	**100%**	**4.51**	**255**	**100%**	**3.35**	**584**	**100%**	**3.16**

VUW			Canterbury			Lincoln			Otago			
Total	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	*Total*	*%*	*Cites*	***Type of access***
58	8%	2.16	21	5%	2.57	16	10%	4.25	133	10%	5.09	**Bronze**
510	72%	2.84	254	63%	3.28	108	66%	3.53	818	62%	3.67	**Closed**
14	2%	1.86	8	2%	2.25	1	1%	0	30	2%	1.47	**Diamond**
50	7%	3.4	47	12%	3.55	27	17%	6.22	222	17%	4.31	**Gold**
65	9%	4.2	52	13%	4.4	9	6%	4.11	87	7%	6.07	**Green**
13	2%	4	20	5%	11.8	2	1%	5	36	3%	6.86	**Hybrid**
710	**100%**	**2.95**	**402**	**100%**	**3.82**	**163**	**100%**	**4.07**	**1326**	**100%**	**4.11**	**Total**

OA version Green or Published?

Where articles were openly accessible we can determine whether this version was the published version of record or Green OA. This table shows results where any author was affiliated with a NZ university.

Best OA version	Count	%	Avg of Crossref citations
Publisher	3701	75%	5.36
Repository	1259	25%	7.52
Total	**4960**	**100%**	**5.91**

- Three quarters of our openly accessible material is available via the publisher.
- The citation rate for Green OA is higher overall.

Green OA not otherwise available theoretical value

This table shows, for NZ affiliated corresponding authors, where a Green OA version is the only one available openly. 'Known APC' shows where APC costs for the article in question could be determined and how much this would have cost if the article was published Hybrid OA.

	Count	Known APCs	Known APC cost	Known APC avg
Green OA version is only accessible version	432	352	$969,824	$2,755

Note the above figure of 432 does not include all copies of NZ research in repositories, only those not otherwise available. Our analysis identified a further 745 articles that had been made available via a repository but are also available on a publisher's site.

Gold and Hybrid theoretical costs

This table shows, where an APC is known via publicly-available data sources, how much would be paid for Gold and Hybrid articles in our sample set. This was calculated only for NZ university-affiliated authors on the basis that the corresponding author is the most likely to be responsible for paying an APC. It is not possible to know where APCs may have been waived or whether they were paid from research funding, institutional funds, researchers' own money or another source.

Type of paid OA	Count	%	Avg of Crossref citations	Known APCs	Known APC cost	Known APC avg
Gold	697	82%	4.74	697	$1,172,029	$1,682
Hybrid	152	18%	6.84	110	$281,378	$2,558
Total	**849**	**100%**	**5.11**	**807**	**$1,453,407**	**$1,801**

Closed article embargo periods and theoretical APC costs

This table shows for NZ-affiliated authors where a closed article may be deposited in an institutional repository and the length of embargo set by the publisher. 'Known APC' shows where APC costs for the article in question could be determined and how much this would cost. All of the articles listed below could be made available now (as of mid-2019) since anything up to two years old would have passed its embargo period. There are a further 213 articles not included in the table that have an embargo period of two years or more.

Embargo period	Publisher policy allows accepted manuscript in repository	%	Avg of Crossref citations	Known APCs	Known APC cost	Known APC avg

12 months	2115	68%	4.62	1917	$5,520,621	$2,880
18 months	318	10%	1.69	316	$932,400	$2,951
3 months	3	0%	3.00	3	$6,145	$2,048
4 months	1	0%	0.00			
6 months	73	2%	3.53	43	$134,565	$3,129
Immediate	580	19%	2.63	471	$1,321,975	$2,807
Total	**3090**	**100%**	**3.92**	**2750**	**$7,915,706**	**$2,878**

Note: of these 3090 articles, for a subset of 114, the published version could be deposited in a repository as opposed to the accepted manuscript.

Top 10 Publishers

This table shows the top ten publishers for NZ corresponding authors by volume and includes the number of unique journals and the total number of articles published with each publisher.

Publisher	No. of journals	% of all journals	No. of articles	% of all articles
Elsevier BV	582	20.38%	1079	20.27%
Wiley-Blackwell	375	13.13%	715	13.43%
Informa UK Ltd / T&F	366	12.82%	681	12.80%
Springer Nature	357	12.50%	658	12.36%
SAGE Publications	159	5.57%	239	4.49%
Emerald	87	3.05%	139	2.61%
Oxford University Press	79	2.77%	116	2.18%
Cambridge University Press	69	2.42%	120	2.25%
MDPI	47	1.65%	144	2.71%
IEEE (Institute of Electrical & Electronics Engineers)	45	1.58%	78	1.47%

- The top four publishers represent 59% of all work published by NZ corresponding authors in our sample set.

Funder information

The following two tables present information where a funding agency was identifiable in the dataset.

New Zealand funding agency and access type

Funders (sorted by number of articles)	No.	closed	% closed	% open	bronze	gold	diam.	hybrid	green
Health Research Council of New Zealand	281	128	46%	54%	38	82	2	9	22
Royal Society of New Zealand	221	120	54%	46%	20	40	2	13	26
Ministry of Business Innovation and Employment	204	137	**67%**	33%	17	29	2	6	13
Medical Research Foundation	100	49	49%	51%	19	25	1	1	5
Auckland Medical Research Foundation	59	28	47%	53%	11	15	1	1	3
Rutherford Discovery Fellowship	58	28	48%	52%	7	9	0	8	6
Heart Foundation	52	26	50%	50%	10	6	0	4	6
Ministry of Health	50	22	44%	56%	5	15	1	4	3
Medical Research Council	47	14	30%	**70%**	6	14	1	4	8
Total	**1072**	**552**	**51%**	**49%**	**133**	**235**	**10**	**50**	**92**

- Overall 51% of funded research is closed.
- MBIE has the highest rate of closed research at 67%. The Medical Research Council has the highest rate of open research at 70%.

New Zealand funding agency: paid OA (Gold+Hybrid) v Green OA and citation rates

Funders (sorted by number of articles)	Gold+ hybrid	Known APCs	Paid Avg citation	Accepted Manusc.	Known APCs	Green Avg citation
Health Research Council of New Zealand	91	$166,326	6.9	128	$369,708	6.7
Royal Society of New Zealand	53	$99,826	7.58	113	$300,803	5.98
Ministry of Business Innovation and Employment	35	$63,709	5.09	129	$350,326	4.4
Medical Research Foundation	26	$46,717	5.65	48	$135,120	5.02
Auckland Medical Research Foundation	16	$26,527	4.94	28	$79,900	6
Rutherford Discovery Fellowship	17	$37,407	8.47	28	$70,823	9.36

Heart Foundation	10	$19,921	4.6	25	$64,645	6.44
Ministry of Health	19	$35,229	3.05	21	$59,652	3.86
Medical Research Council	18	$33,333	5.83	14	$40,980	4.86
Total	**285**	**$528,995**	**5.79**	**534**	**$1,471,957**	**5.85**

- 285 articles were made available via a paid OA option and around twice that (534) via Green OA.
- Around half a million dollars may have been paid in APCs. The theoretical value of Green OA is around $1.5m.
- Citation rates for Green OA are comparable and on average slightly higher than paid OA.

Appendix 3: Leiden Ranking data

The Leiden Ranking uses a different method to that employed by our group, including using data from 2014-17 as opposed to the single year in our sample set, but produces a similar result to our figure for the proportion of NZ research that is openly available in some form.

The data available on the Leiden Ranking website includes universities based on their number of Web of Science indexed publications, adjusted for the number of non-local co-authors. Auckland, Massey, VUW, Canterbury, and Otago were included under this criteria[30], and the researchers kindly provided data for AUT, Waikato and Lincoln on request.[31] This let us get a full picture across all NZ universities.

Percentage of OA papers published by all NZ universities

University	# Papers	# OA papers	Percentage OA
University of Auckland	11,061	4,263	38.6%
AUT	1,915	716	37.4%
University of Waikato	1,537	598	38.9%
Massey University	3,974	1,311	33.0%
VUW	3,048	1,052	34.5%
University of Canterbury	3,461	1,513	43.7%
Lincoln University	958	296	30.9%
University of Otago	7,577	3,127	43.7%
Total	**33,501**	**12,876**	**38.4%**

Percentage of OA papers published by Leiden-ranked universities in selected countries

The numbers below are the totals for Leiden-ranked universities only, thus excluding AUT, Waikato and Lincoln data for the purposes of equivalent comparisons; this only minimally affects the percentage.

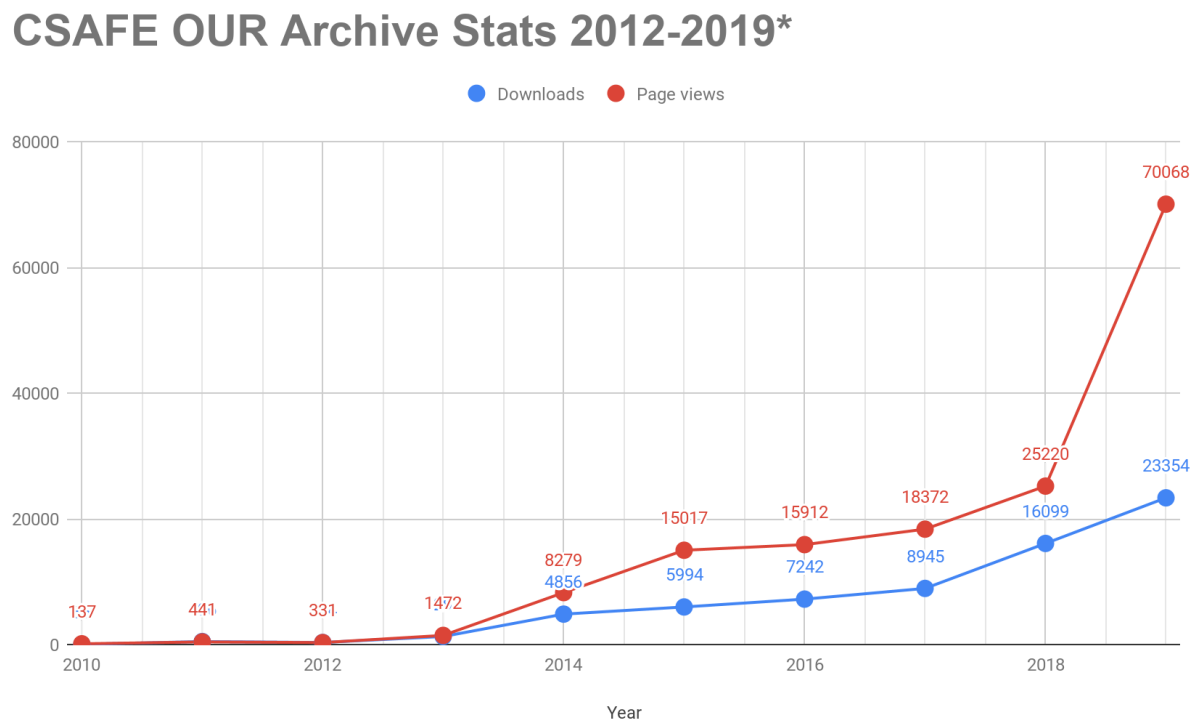
University	# Papers	# OA papers	Percentage OA
New Zealand	29,091	11,266	38.7%
Canada	281,304	117,247	41.7%
Australia	273,486	113,789	41.6%
UK	454,802	322,827	71.0%
US	1,876,219	1,013,502	54.0%
Norway	42,608	23,109	54.2%
Ireland	26,548	12,966	48.8%
Germany	397,439	190,543	47.9%

[30] Centre for Science and Technology Studies (2019). *CWTS Leiden Ranking 2019.* Retrieved from www.leidenranking.com/ranking/2019/

[31] CWTS using Web of Science by Clarivate Analytics in combination with Unpaywall.

Appendix 4: CSAFE deposit policy effect on access to work

Data for downloads and page views for the Centre for Sustainability, Agriculture, Food and the Environment (CSAFE) as reported in the University of Otago institutional repository. While such data can be a blunt measurement tool, the trend is clear with a nearly fivefold increase in downloads from 2014 to the (projected) end of 2019.



** 2019 figures are projected using 1 Jan - 30 Jun and multiplying by two*

Notes:

- Data obtained directly from the repository's public usage statistics for CSAFE.
- The number of items in the repository at given dates was not systematically recorded. However, we do know that there were 187 records in February 2016, 223 in February 2018 and 257 in July 2019.
- In the summer months of 2014/15 the Centre deposited as much of its previous five years' research outputs as was legally possible, developing an internal process for this in the process. Deposits were made by support staff not researchers and this practice was continued when it became business-as-usual.

Appendix 5: Definitions

Type of OA	Definition
Gold OA	Published version is immediate OA. APC charged.
Hybrid OA	Publication is subscription-based. APC can be paid to make individual articles OA.
Bronze OA	Free to read on publisher's site but licence not clear.
Green OA	Free to read in a reputable repository (i.e. academic social networking sites are not included). Publisher's version is paywalled.
Closed	Published version is paywalled.
Diamond OA	Published version is free to read. No APC charged.

Bibliography

Blankstein, M., & Wolff-Eisenberg, C. (2019). *Ithaka S+R US Faculty Survey 2018*. Retrieved from doi.org/10.18665/sr.311199

Carlson, S. MacKie-Mason, J, Waibel, G (2019) Update on open access and academic journal contracts: Presentation to the Board of Regents' Academic and Student Affairs Committee https://osc.universityofcalifornia.edu/wp-content/uploads/2019/07/UpdateOnOpenAccessAndAcademicJournalContracts_UCBoardOfRegentsAcademicAndStudentAffairsCommittee_17July2019.pdf

Council of Australian University Librarians (2018*). CAUL Review of Australian Repository Infrastructure*. https://www.caul.edu.au/sites/default/files/documents/meetings/cairss2018martin-40m.pdf

Council of Australian University Librarians (2017). *Summary Statistics.* Data retrieved from statistics.caul.edu.au/pre2018/inst_data.php

Council of Australian University Librarians (2019). *CAUL Fair, affordable and open access to knowledge program. CAUL Review of Australian Repository Infrastructure.* Retrieved from https://www.caul.edu.au/sites/default/files/documents/fair-access/repositories2019program-report.pdf

Council of Australian University Librarians. (2019). *CAUL Statement on Open Scholarship 2019* Retrieved from https://www.caul.edu.au/sites/default/files/documents/scholcomm/open-scholarship2019.pdf

Council of Australian University Librarians. (2019). *Collection & reporting of APCs*. Retrieved from https://www.caul.edu.au/programs-projects/fair-affordable-open-access-knowledge/collection-reporting-apcs

Centre for Sustainability, University of Otago. https://ourarchive.otago.ac.nz/handle/10523/4805

Centre for Science and Technology Studies (2019). *CWTS Leiden Ranking 2019.* Retrieved from www.leidenranking.com/ranking/2019/

Coaltion S (2019). Plan S: Principles and implementation. Retrieved from www.coalition-s.org/principles-and-implementation/

Centre for Open Science. (.n.d.). *OSF Preprints*. https://osf.io/preprints/

Johnson, R., Pinfield, S., & Fosci, M. (2016). Business process costs of implementing "gold" and "green" open access in institutional and national contexts. *Journal of the Association for Information Science and Technology, 67*(9), 2283-2295. doi.org/10.1002/asi.23545

Hoban, V. (2018). The crusade for open access, and what the Library is doing to help, explained. Retrieved from https://news.lib.berkeley.edu/crusade-open-access-and-what-library-doing-help-explained

Larivière, V. & Sugimoto, C.R. (2018). Do authors comply when funders enforce open access to research? *Nature 562*, 483-486. doi: 10.1038/d41586-018-07101-w

Mamtora, Jayshree and Pandey, Prashant (2018) *Identifying the role of open access information in attaining the UN Sustainable Development Goals*. Paper presented at: IFLA WLIC 2018 – Kuala Lumpur, Malaysia – Transform Libraries, Transform Societies in Session 205 - Asia and Oceania. library.ifla.org/2110/1/205-mamtora-en.pdf

Matthias, L. (2018). lmatthia/publisher-oa-portfolios v1.0 (Version v1.0). *Zenodo*. doi: 10.5281/zenodo.2459746

Milmo, Cahal. (5 Nov 2015). 'Lingua: Entire editorial team of respected linguistics journal resign en mass in turf war over publishing,' The Independent. Accessed 19 July 2019. www.independent.co.uk/news/world/europe/lingua-entire-editorial-team-of-respected-linguistics-journal-resign-en-mass-in-turf-war-over-a6723036.html

Open Access 2020. https://oa2020.org

Open Access Button 269696 requests for access recorded at openaccessbutton.org/request. Accessed 2 July 2019.

Piwowar H, Priem J, Larivière V, Alperin JP, Matthias L, Norlander B, Farley A, West J, Haustein S. 2018. The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ* 6:e4375 doi.org/10.7717/peerj.4375

QS methodology www.topuniversities.com/qs-world-university-rankings/methodology;

Times Higher Education (2018). World university rankings 2018 methodology. Retrieved from www.timeshighereducation.com/world-university-rankings/methodology-world-university-rankings-2018;

Academic Ranking of World Universities. (2018). Methodology. Retrieved from www.shanghairanking.com/ARWU-Methodology-2018.html.

SPARC (n.d.) *Big deal cancellation tracking.* Retrieved from https://sparcopen.org/our-work/big-deal-cancellation-tracking/

Te Kāhui Amokura https://www.universitiesnz.ac.nz/about-universities-new-zealand/unz-committees-and-working-groups/te-k%C4%81hui-amokura

Vincent- Lamarre, P. , Boivin, J. , Gargouri, Y. , Larivière, V. and Harnad, S. (2016). Estimating open access mandate effectiveness: The MELIBEA score. *J Assn Inf Sci Tec*. 67: 2815-2828. doi:10.1002/asi.23601

White, R., & Remy, M. (2017). University of Otago Open Access Publishing Survey Results (including Maori ethnicity results) (Project Report). Retrieved from hdl.handle.net/10523/7333

Wilson, M. (2017). Universities spend millions on accessing results of publicly funded research. *The Conversation.* Retrieved from. https://theconversation.com/universities-spend-millions-on-accessing-results-of-publicly-funded-research-88392